A Summary of the Construction Industry Institute (CII)

RT 272 Studies on Work Packaging for Increased Safety, Productivity, and Predictability

by Rusty Haggard, Industry Author and Former CII Staff (1985 – 2009)
Owners and constructors both want to improve project success. To accomplish this, the engineering and construction industry has tried for years to employ best practices, vary work shifts, use incentive packages, and much more — all in an effort to improve not only productivity, but also safety, worker retention and morale, schedules, and consistency. Unfortunately, no definitive process has dramatically improved construction in these areas and problems persist even after decades of trying.

However, recent research by two well-respected industry organizations points to the process known as advanced work packaging (AWP) as an answer. The data back up their claim. The Construction Industry Institute (CII) and the Construction Owners Association of Alberta (COAA) recommend AWP and have published exhaustive volumes of research, data analysis, expert interviews, and case studies in support of the idea that AWP and the accompanying detailed planning and other processes associated with AWP work together to increase productivity, safety, craft retention, and other measures of what makes a successful construction project.

CII, perhaps the most well-known and most widely respected construction research group in the world, began its study of work packaging in 2009. COAA was a contributor to that research from the beginning and the two joined forces to jointly sponsor a second phase of research in 2011. The resulting 400 pages in three volumes, published by CII in 2013, are extensive and impressive; indeed, a company could base its entire construction program on the information found there.

Recognizing the daunting nature of digesting the full 400-page CII report, let’s summarize these materials, highlighting the definitions, opportunities, and quantitative results.

Definitions
Identifying the relevant terms is the appropriate starting point for defining important aspects of AWP:

- **Work Packaging** — the process of breaking down a project into manageable tasks. Work packaging is done on all projects, even if it’s not specifically referred to in such a manner. The problem is that the process is done differently by each company and on each project. It’s not repeatable and it’s that very inconsistency from project to project that helps breed inefficiency.

- **AWP** — a more standards-based approach to work packaging, this formalizes the components and methodology for construction execution and includes engineering work packages (EWPs), construction work packages (CWPs), and installation work packages (IWPs). AWP is a construction-driven process that begins with front-end planning and detailed design and continues through construction execution at the workface in the field and on to handover and start-up. AWP, because it is construction-driven, begins with the end in mind; thus, construction input to the engineering and design stage is a must.

- **WBS (work breakdown structure)** — a hierarchical representation of a complete project.
**EWP** (engineering work package) – an engineering and procurement deliverable used to create a CWP. This typically includes scope of work with document list; drawings; installation and materials specs; vendor data; bill of materials; equipment and/or line lists; and permitting studies if required. Construction knowledge and input is vital to EWPs, which are subordinate to the project execution plan and the sequence and timing of construction work packages.

**CWP** – defines a logical and manageable division of work within the construction scope. CWPs do not overlap within a discipline; are designed to be measurable and in alignment with project controls; are used to develop installation work packages; and may contain more than one EWP. They typically consist of safety requirements, at least one EWP, the schedule, the budget, environmental requirements, quality requirements, and any special resource requirements such as permits, and so on. CWPs are usually used to determine contractual scopes of work, are developed from the contract formulation through construction execution, and grow over time to include productivity factors, detailed cost reports, and other considerations.

**IWP** – a deliverable that enables a crew to work in a safe, predictable, measurable, and efficient manner; typically limited in size such that a crew can perform the completed tasks in a set amount of time, for example 500 hours. IWPs contain all necessary documentation supporting execution of the work at the workface (in the field). They typically include a work package summary, quantity work sheet, safety hazard analysis, specific tasks, material safety data sheet(s), drawings, specs, change documents, manufacturer’s installation instructions, model shots, bill of materials, required tools, installation test result forms, as-built documentation, inspection checklists, and completion verification signatures.

**Opportunities**

The CII research demonstrates that using work packaging methodologies presents attractive opportunities for both constructors and owners.

**Productivity**

It is estimated that labor represents 40 percent of a typical construction project cost. Studies show that, unfortunately, two-thirds of labor time is spent waiting or looking for material, being idle, traveling, and other nonproductive issues. CII’s research demonstrated that AWP can provide up to a 25 percent reduction in labor costs because, if executed properly, it minimizes losses through a more detailed execution planning strategy and reduces idle time through the ability to more effectively assign craft labor through increased visibility into the availability of materials and the status of dependencies.

AWP provides structure for focused execution planning that is directed at the construction workface (in the field) by facilitating collaboration between engineering and construction during the planning phase. AWP is designed to support construction and proper sequencing of the supply chain. The key is to remove or address all constraints to every work package. In this way, IWPs in the field are clear, which allows superintendents and foremen to spend time mentoring crafts and avoiding crisis management. In the field, AWP provides tight definitions for all work to be executed. All materials are in place for the task at hand. The results are improved safety and quality, reduced work hours, more reliable predictability, and better performance in regard to meeting schedule requirements. The reasons for these improvements is the fact that AWP provides assurance that engineering documents are delivered on time and are accurate, even with the accompanying aggressive but attainable completion dates and times.
Predictability

Construction is typically known to contain a lot of variables. The ability to plan for these variables can separate great contractors from average ones and successful projects from failures. AWP provides that predictability with regard to variables. An effective work package is a tool for managing variances, building flexibility, and accommodating change. AWP breaks down projects into manageable packages – that is, those that can be completed in a known timeframe when materials are on hand and the crew understands the scope of work through the issuance of IWP’s. It is extremely important that all constraints to every IWP be removed before work in the field is begun. Removing guesswork and uncertainty and following a focused and organized execution plan allows project management to improve morale, turnover, and safety. The key is tying AWP to the procurement process in great detail.

Challenges and Requirements

Information systems compatibility, information mobility, and information handover

This particular challenge has long plagued the industry and is a known challenge outside of AWP. This is due in large part to the disparate systems and file formats used in engineering and construction and the sheer volume of information to be managed and shared during construction and into commissioning and handover. While AWP can deliver significant benefits, it requires information mobility and the ability to recognize the relationships among separate data points as well as more real-time access to project progressing and the incorporation of that progressing information into the holistic project plan in a continuous manner.

Implementation

Those interested in using AWP must understand the need for all of the project stakeholders to embrace the approach. AWP is process-related – that is, it involves participation from front-end planning and early design with regard to alignment in those stages with the construction execution plan. AWP is an organizational opportunity as well, and works best when workflow planning “champions” are identified to carry out IWP’s in the field. Finally, a cultural shift must occur when using AWP in an organization because of the required alignment between engineering and construction and the inherent differences in work methods involved in these two important stakeholder organizations.

Research and Quantitative Impact

Far from just presenting AWP as a concept, CII and COAA conducted extensive research and case studies on the topic. The results of their multi-year research effort, which included evaluating the impact of AWP on several actual projects, indicated the following benefits to projects using AWP:

- More efficient rate of installation
- On-time project completion
- Lower rework
- Improved safety planning and awareness
- Improved front-end planning
• Improved overall project predictability
• Reduced cost
• Better alignment between engineering and construction
• Improved foreman performance
• Above-average retention rate among crafts
• Improved quality of reporting from effective progress tracking
• Improved customer/stakeholder satisfaction

Quantitative benefits were highlighted on numerous projects. For example, CII noted that positive outcomes for a project that implemented advanced work packaging include the following:

• Superior safety performance – 0.21 TRIR
• Productivity factor was 11 percent better than budget
• Project finished 10 percent under budget
• Field rework less than 0.5 percent

AWP in Action

When implementing AWP, detailed project planning is extremely important. Construction input is needed and required in front-end planning by engineering and design, which is a challenge considering the traditional incompatibility between the systems and processes of those two disciplines.

Moreover, all of the parties engaged on a project must agree to participate in the AWP process and to understand their specific duties and obligations to make AWP work.

While the relatively new paradigm of AWP presents somewhat of a learning curve and cultural shift, the effort is extremely worthwhile. Knowing the collaborative effort needed between engineering and construction will result in more open communications and trust between these two important stakeholders. And, although initial costs will increase slightly due to the technologies and/or increased efforts required for AWP, these costs and efforts will be easier to bear if one remembers that 25 percent savings in labor and 10 percent savings in total install costs are achievable when using AWP.

About the author: Rusty Haggard has written for the oil and gas industry, project management, engineering and construction, and chemical and microbiology companies. He was the staff technical writer/editor for the Construction Industry Institute from 1985 until 2009 and in 2011 he authored “Khurais: Against All Odds” for Saudi Aramco, a 300-page account of the company’s largest project to date.